Software developments on Gemini

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In addition to the finer north and south amplifier energy control there have been a number of other developments in the software used in Gemini.

Operating system upgrade

We took advantage of the cessation of support for Windows XP to upgrade of all of our control and monitoring PCs to Windows 10. Many of these machines have been running since 2009, and unsurprisingly, the requirements for operations have altered considerably during this time, so the software was modified to streamline the process. We took the opportunity to add some useful features such as better configurability of parameters, and automatic switching of filters for cameras according to laser energy mode. We also replaced many of our outdated Firewire cameras with GigE equivalents, and are in the process of upgrading some of the original motion stages. Although this exercise has been complex and not straightforward, these changes will put us in a good position to continue to support the facility in the future.

User control and shot automation

A recent experiment in TA2 required a fairly fast (every few seconds) feedback loop between the Dazzler in the Gemini front end and a PC which analysed the parameters of the laser-produced electron beams, then modified the settings for the Dazzler to optimize the beam parameters. The most effective way of achieving this type of feedback was to allow the analysis software to "control" the main laser Control System, initiating shots via the PC that was performing the analysis. After some debugging the system worked well, and could potentially be expanded to include other semi-automated functionality. It is important to note here that the range of Dazzler parameters that the analysis software could apply was restricted to a relatively small range. This is because the pulses are delivered alternately to Target Area 2 and Gemini, and large changes to the Dazzler settings for the TA2 pulses can change the thermal conditions in the amplifiers, thereby affecting the pulses sent to Gemini.

Improvements in data analysis

One problem experienced by users is the synchronisation of their experimental data with laser diagnostics across multiple, embargoed, networks. To address this problem we recently installed a tool called DARB (Diagnostics, Analysis, Review and Backup), written in collaboration with the University of Strathclyde. DARB is described in more detail elsewhere.
As part of their on-going international scientific data curation programme, the Scientific Computing Department have upgraded the ICAT database on which eCAT is based to the latest version – version 4.8. One feature of this upgrade is the introduction of a more SQL-like query language which should enable more complex queries to be performed in the database rather than code, thus improving performance.

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Measurement of femtosecond-scale drift and jitter of the delay between the North and South Beams of Gemini

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We describe an experimental technique for measuring femtosecond-scale drift and jitter in the delay between Gemini's North and South beams. This technique, based on spectral interference, was successfully employed in both an off-shot and on-shot capacity for an f/2-f/40 setup. However, the technique itself could be adapted with little difficulty to other focusing geometries.

The delay between the North and South beams was monitored over long periods with a precision of (10.3 ± 0.7) fs using both the off-shot and on-shot diagnostics. It was found that the delay oscillated on the scale of tens of fs over 10-20 minute timescales and correlated strongly with temperature variations of 1°C measured in the laser area.

The on-shot diagnostic showed good agreement with the off-shot measurements and could, in the future, be used in the development of an automated timing stabilization system.

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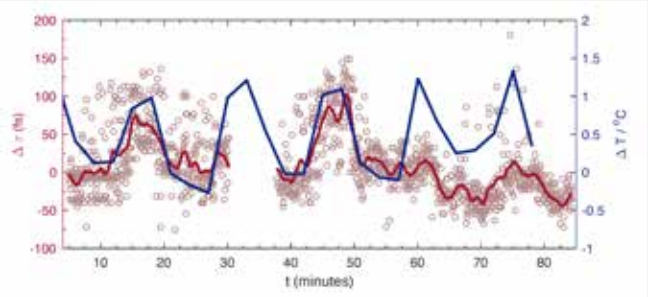

Change in delay between North and South beams measured in TA3 (moving average in red line) against time compared to temperature measured in LA3 (blue line).